

## WHAT IS CLAIMED IS:

- > 1. A data card comprising:  
a substrate having first and second edges and a data surface region formed therebetween and wherein said substrate includes at least one layer of a non-magnetic material adapted to receive at least one layer of magnetic material forming the data surface region.
2. The data card of claim 1 wherein said substrate includes a material selected from the group of a metal substrate, a glass substrate, a ceramic substrate, a glass-ceramic substrate and a resin substrate.
3. The data card of claim 1 wherein said substrate comprises outer layers bonded to said at least one layer.
4. The data card of claim 1 wherein said substrate is formed of said at least one layer as a single layer comprising a glass-ceramic material.
5. The data card of claim 1 wherein said substrate comprises outer layers bonded to a center layer as said at least one layer and wherein said center layer is a glass material.
6. The data card of claim 1 wherein said substrate comprises outer layers bonded to a center layer as said at least one layer and wherein said center layer is a glass-ceramic material.
7. The data card of claim 5 wherein the outer layers comprise plastic material.

8. The data card of claim 6 wherein the outer layers comprise plastic material.

9. The data card of claim 1 wherein said outer layers comprise plastic material, said center layer comprises a glass material and said data surface region comprises a magnetic recording media.

10. The data card of claim 1 wherein said outer layers comprise plastic material, said center layer comprises a glass-ceramic material and said data surface region comprises a magnetic recording media.

11. The data card of claim 1 wherein said substrate comprises a single layer of glass material and said data surface region comprises a magnetic media.

12. The data card of claim 1 wherein said substrate comprises a single layer of glass-ceramic material and said data surface region comprises a magnetic media.

13. The data card of claim 1 wherein said substrate includes outer layers which are generally coplanar with said at least one layer and said data surface region.

14. The data card of claim 13 wherein said substrate is generally rectangular in shape.

15. The data card of claim 1 wherein said substrate is formed of a glass material formed of a composition having a coefficient of expansion substantially similar to that of an aluminum alloy substrate material.

16. The data card of claim 1 wherein said substrate is formed of a glass-ceramic material formed of a composition having a coefficient of expansion substantially similar to that of an aluminum alloy substrate material.

17. The data card of claim 1 wherein the said data surface region comprises a magnetic stripe region adapted to cooperate with a data card reader comprising a magnetic stripe reader for reading information from the magnetic stripe region.

18. The data card of claim 1 wherein said substrate is configured to a rectangular substrate having edges.

19. A data card comprising:

a substrate having first and second edges and a data surface region therebetween wherein said substrate comprises a center layer and wherein said center layer comprises a glass material.

20. A data card comprising:

a substrate having first and second edges and a data surface region therebetween wherein said substrate comprises a center layer and wherein said center layer comprises a glass-ceramic material.

21. The data card of claim 20 wherein said outer layers comprise plastic material.

22. The data card of claim 20 wherein said outer layers comprise plastic material.

23. The data card of claim 20 wherein said outer layer comprises plastic material, said center layer comprises a glass material and said data surface region comprises a magnetic recording media.

24. The data card of claim 20 wherein said outer layer comprises plastic material, said center layer comprises a glass-ceramic material and said data surface region comprises a magnetic recording media.

25. The data card of claim 20 wherein said data surface region comprises nickel-cobalt.

26. The data card of claim 20 wherein said data surface region comprises nickel-cobalt.

27. The data card of claim 20 wherein said data surface region extends to at least one of said first and second edges.

28. The data card of claim 20 wherein said substrate includes outer layers which are generally coplanar with the center layer and said data surface region.

29. The data card of claim 20 wherein said substrate is generally rectangular in shape.

30. The data card of claim 20 wherein the data surface region comprises a magnetic stripe region adapted to cooperate with a data card reader comprising a magnetic stripe reader for reading information from the magnetic stripe region.

31. The data card of claim 29 wherein said substrate is configured to a rectangular substrate having edges and said data surface region is formed of a magnetic media.

32. A data unit comprising,

a data card comprising

a substrate having first and second edges and a data surface region therebetween wherein said substrate comprises at least one layer comprising a non-magnetic material;

a data card reader comprising

a base;

a substrate support, configured to support said substrate, mounted to the base for controlling movement along a first path;

first and second data head support surfaces positioned at opposite ends of a second path and adjacent to said substrate support, said first and second paths being transverse to one another; and

a data head drive mounted to the base, the data head drive comprising a data head reciprocally movable along the second path, said data head comprising a data head surface which contacts said first and second data head support surfaces as said data head moves along the opposite ends of said second path.

33. A data storage card comprising

a non-magnetic substrate having first and second edge;

a data surface region located on said non-magnetic substrate between said first and second edges, said data surface region comprising a magnetic storage medium having at least one layer of high density, high coercivity magnetic material for storing magnetic signals.

34. The data card of claim 33 further comprising a relatively hard, abradable protective coating formed on said magnetic material layer and being selected to have a thickness between a maximum thickness which would materially attenuate magnetic signals passing between said magnetic material layer and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of the protective coating.

35. The data storage card of claim 33 wherein said at least one magnetic material layer is a thin film layer of high density, high coercivity magnetic material having a predetermined magnetic field orientation for storing data.

36. The data storage card of claim 34 wherein said protective coating has at least one layer which includes a magnetically permeable, magnetically saturable material.

37. The data storage card of claim 34 wherein said protective coating has at least two layers wherein one of said layers includes a magnetically permeable, magnetically saturable

material and the other of said layers is a non-magnetic friction reducing layer formed on said one of said layers.

38. The data storage card of claim 33 wherein said at least one magnetic material layer is formed of a high density, high coercivity magnetic material having a predetermined magnetic field orientation and wherein said protective coating has at least one layer which includes a magnetically permeable, magnetically saturable material and wherein said data storage device further includes

a non-magnetic material layer positioned between the protective coating and said at least one magnetic material layer, said magnetically permeable, magnetically saturable material being responsive through said non-magnetic layer to predetermined magnetic field orientation to produce a magnetic image field in a direction opposite to said predetermined magnetic field orientation.

39. The data storage card of claim 33 said at least one magnetic material layer is formed of a high density, high coercivity magnetic material having a predetermined magnetic field orientation and wherein said protective coating has at least two layers wherein said one of said layers includes a magnetically permeable, magnetically saturable material and the other of said layers is a non-magnetic abrasion friction reducing layer formed on said one of said layers and wherein said data storage device further includes

a non-magnetic material layer positioned between the protective coating and said at least one magnetic material layer, said magnetically permeable, magnetically saturable material being responsive through said non-magnetic layer to predetermined magnetic field orientation to produce a magnetic image field in a direction opposite to said predetermined magnetic field orientation.

40. The data storage card of claim 33 wherein said protective coating is adapted to interface with and be responsive to a data processing station when said substrate and data processing station are moved relative to each other to position said substrate proximate said data processing station to enable data flow therebetween.

41. The data storage card of claim 33 wherein said substrate is moved relative to said data processing station.

42. The data storage card of claim 33 wherein said data processing station is moved relative to said substrate.

43. The data storage card of claim 33 wherein said data processing station and said substrate are moved relative to each other.

44. The data storage card of claim 33 wherein said substrate is substantially planar and generally rectangular in shape and said data storage device is generally rectangular in shape.



45. The data storage card of claim 44 wherein said substantially planar and generally rectangular shaped substrate including said data storage device is transported past a data processing station.

46. The data storage card of claim 33 wherein said thin film layer of magnetic material has an areal density of about 2 megabits per sq. in. to about 10 gigabits per sq. in.

47. A portable data storage card adapted to be used in a card processing system having a data processing station comprising

a data storage device adapted to interact with a data processing station when a portable card and a data processing station are moved relative to each other, said data storage device including

a non-magnetic substrate having a predetermined shape;  
at least one layer of high density, high coercivity magnetic material for storing magnetic signals; and

a relatively hard, abradable protective coating formed on said magnetic material layer and being selected to have a thickness between a maximum thickness which would materially attenuate magnetic signals passing between said magnetic material layer and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of the protective coating.

48. The portable data storage card of claim 47 wherein said non-magnetic substrate material is selected from the group of a metal substrate, a glass substrate, a ceramic substrate, a glass-ceramic substrate and a resin substrate.

49. The portable data storage card of claim 47 wherein said protective coating is adapted to interface with and be responsive to a data processing station when said substrate and data processing station are moved relative to each other to position said substrate proximate said data processing station to enable data flow therebetween.

50. The portable data storage card of claim 47 wherein said substrate is moved relative to said data processing station.

51. The portable data storage card of claim 47 wherein said data processing station is moved relative to said substrate.

52. The portable data storage card of claim 47 wherein said data processing station and said substrate are moved relative to each other.

53. A card and card writer/reader system comprising  
an encodeable card having

a body having upper and lower surfaces and side and end edges, said body including on at least one of said upper and lower surfaces a data storage section, said card being adapted to interact with a data processing station when said card and

said data processing station are moved relative to each other to at least one of write encoding signals in said data storage section and read encoded signals from said data storage section, said data storage section including

a non-magnetic substrate;

at least one layer of high density storage material for storing data, and

a diamond-like hardness, abradable protective coating formed on said at least one high density storage material layer and being selected to have a thickness between a maximum thickness which would materially attenuate encoding and encoded signals passing between said storage material layer and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of the protective coating; and

a writer/reader having a transducer for at least one of writing encoding signals in said data storage section and reading encoded signals from said data storage section during relative movement of said card relative to the data processing station to enable data flow between said data storage section and said transducer.

54. The card and card writer/reader system of claim 53 wherein said an encodeable card is a magnetically encodeable card and wherein said data storage section has at least one thin

film layer of high density, high coercivity magnetic material having a predetermined magnetic field orientation for storing data.

55. A method for reading a card with a card reader comprising the steps of

forming on a non-magnetic substrate of a card a data storage section a data surface region comprising a magnetic storage medium having at least one layer of high density, high coercivity magnetic material for storing magnetic signals adapted to interact with a data processing station when said card and said data processing station are moved relative to each other to at least one of write encoding signals in said data storage section as encoded signals and read encoded signals from said data storage section;

forming a relatively hard, abradable protective coating on said data storage section wherein said protective coating has a thickness between a maximum thickness which would materially attenuate encoding and encoded signals passing between said data storage section and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of the protective coating; and

moving said card and data processing station relative to each other to interface said data storage section relative to a transducer to enable data flow therebetween.

56. The method of claim 55 wherein the step of forming includes forming a data storage device having at least one thin film layer of high density, high coercivity magnetic material having a predetermined magnetic field orientation for storing data.

57. The method of claim 55 wherein said step of moving includes using a transducer that is an inductive head.

58. A method for reading a card with a card reader comprising the steps of

forming on a non-magnetic substrate of a card a data storage section including a thin film of magnetic material having a predetermined magnetic orientation for storing data in a predetermined axis;

forming on said data storage section a bendable, diamond like hardness protective coating having a thickness which allows passage of magnetic signals in an ambient natural atmospheric operating environment through said protective layer and said thin film layer, said protective layer being formed of a material which resists at least one of chemical, magnetic and mechanical degradation of the data storage device; and

moving said card and data processing station relative to each other to interface said data storage section relative to a transducer to enable data flow therebetween.

59. A data storage device comprising  
a non-magnetic substrate;

at least one layer of high density, high coercivity magnetic material formed on said non-magnetic substrate for storing data; and

a relatively hard, abradable protective coating formed on said magnetic material layer and being selected to have a thickness between a maximum thickness which would materially attenuate magnetic signals passing between said magnetic material layer and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of said protective coating material.

60. The data storage device of claim 59 wherein said protective coating is of a diamond-like hardness forming a bendable, abradable protective coating.

61. A data storage device comprising

a non-magnetic substrate;

a substrate having at least one surface;

at least one high density magnetically coercive material layer disposed on said substrate for storing magnetic signals with the coercive material axis of magnetization oriented in a predetermined direction relative to said at least one surface of said substrate; and

a bendable, diamond like hardness protective coating having a thickness which allows passage of magnetic signals in an ambient natural atmospheric operating environment through said

protective layer and between said at least one high density magnetically coercive material layer and a transducer, said protective layer being formed of a material which resists at least one of chemical, magnetic and mechanical degradation of the data storage device.

62. A magnetic signal processing apparatus comprising a magnetic recording medium having

- a non-magnetic substrate;
- a high density magnetically coercive material for storing magnetic signals with the coercive material axes of magnetization oriented in a predetermined direction;
- a bendable, relative hard, protective coating including a magnetically permeable, magnetically saturable material disposed on said exchange break layer and being responsive through said exchange break layer to the coercive material axes of magnetization to produce a magnetic image field in a direction opposite to said predetermined direction, said protective coating being selected to have a thickness between a maximum thickness which would materially attenuate magnetic signals passing between said magnetic material layer and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of the protective coating; a magnetic transducer positioned

relative to a surface of said recording medium for transferring signals with respect to the recording medium; and

a drive member operatively coupled to at least one of said transducer and said recording medium to provide relative movement therebetween.

63. In a method of processing magnetic signals using a magnetic recording medium having a high density magnetically coercive material for storing magnetic signals with the coercive material axes of magnetization oriented in a predetermined direction comprising the steps of:

providing a non-magnetic substrate for supporting said a high density magnetically coercive material;

providing a layer of a non-magnetic material disposed on said high density magnetically coercive material for defining a exchange break layer;

providing a protective coating including a magnetically permeable, magnetically saturable material which is disposed on said exchange break layer and responsive through said exchange break layer to the coercive material axes of magnetization to produce a magnetic image field in a direction opposite to said predetermined direction, said protection coating being formed of a material which resists at least one of chemical, magnetic and mechanical degradation of the magnetic recording medium; and

generating with a magnetic control device having a bias field adapted to increase through said protective coating and



said exchange break layer the reluctance of said magnetic saturable, magnetically permeable material to enable the magnetic signal to pass between said high density magnetically coercive material through said exchange break layer and said protective coating to a magnetic transducer.

64. A system comprising

a magnetic recording medium having

a non-magnetic substrate;

a high density magnetically coercive material for storing magnetic signals formed on said non-magnetic substrate with the coercive material axes of magnetization oriented in a predetermined direction:

a non-magnetic material disposed on said high density magnetically coercive material for defining an exchange break layer;

a relatively hard, abradable protective coating formed on said magnetic material layer and being selected to have a thickness between a maximum thickness which would materially attenuate magnetic signals passing between said a high density magnetically coercive material and a transducer and a minimum thickness enabling said protective coating to be abraded by usage in an ambient natural atmosphere operating environment for removing therefrom a known quantity of the protective coating;

a magnetic transducer positioned relative to a surface of said recording medium for transferring signals with respect to the recording medium;

a drive member operatively coupled to at least one of said transducer and said recording medium to provide relative movement therebetween;

a magnetic control device having a bias field adapted to increase through said protective coating the reluctance of said magnetic saturable, magnetically permeable material to enable the magnetic signal to pass between said high density magnetically coercive material through said exchange break layer and said protective coating to said magnetic transducer; and

a programmable control device operatively connected to said magnetic control device to cause said bias field to be applied to said recording medium when a selected magnetic image is located substantially adjacent said transducer.

65. The system of claim 64 wherein said protective coating has at least one layer which includes a magnetically permeable, magnetically saturable material.

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